

Appendix A – Ecological Assessment Reports for the Albemarle Kemerton Plant 2017

Eco Logical Australia 2017b



Kemerton Industrial Area Additional Assessment of Proposed Access Road Area

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Abbreviations

Abbreviation	Description
BoM	Bureau of Meteorology
DEC	Department of Environment and Conservation
DotEE	Department of the Environment and Energy
ELA	Eco Logical Australia
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FCT	Floristic Community Type
ha	Hectares
IBRA	Interim Biogeographical Regionalisation for Australia
km	Kilometers
mm	Millimeters
Parks and Wildlife	Department of Parks and Wildlife
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
S2V	S2V Consulting
TEC	Threatened Ecological Community
WA	Western Australia
WC Act	<i>Wildlife Conservation Act 1950</i>

Executive summary

Eco Logical Australia was engaged by S2V Consulting to undertake a desktop study and site inspection of an area (study area) associated with a potential future spine road that may be utilised to provide access to a proposed industrial facility in the Kemerton Industrial Area, south-west Western Australia. The purpose of this work was to develop a stand-alone report with the purpose of supporting approvals documentation for development of the access road/s.

As part of this work, Eco Logical Australia reviewed existing reports and data for the broader Kemerton Industrial Area and undertook a site inspection to verify and update findings of the desktop assessment where required. The site inspection was undertaken over a single day on the 6 July 2017.

The conservation significant flora species *Acacia semitrullata* (Priority 4), has been previously recorded within the study area and was observed during the site inspection. This species occurs in remnant vegetation in Good or better condition in the south-east and western parts of the study area. *Caladenia speciosa* (Priority 4) has also previously been recorded in vegetation in the south-east corner of the study area.

Eight vegetation communities were described in the study area during the site inspection. Of these vegetation communities, three are considered to represent the *Environmental Protection and Biodiversity Conservation Act 1999* listed 'Banksia Woodlands of the Swan Coastal Plain' Threatened Ecological Community. Previous studies have also found vegetation communities within the study area which closely resemble the Priority Ecological Community 'Low lying *Banksia attenuata* woodlands or shrublands' (Priority 3). This Priority Ecological Community is however not currently recognised by the Department of Parks and Wildlife as occurring within the study area, with the closest mapped occurrence located approximately 2 kilometres to the south-west.

The condition of native vegetation within the study area ranges from Excellent to Completely Degraded. The most intact areas of native vegetation with the highest quality are in the south east corner and along the western edge of the study area. Remaining areas of the study area are in Completely Degraded condition due to historical clearing and land uses (e.g. pine plantations, grazing).

One conservation significant species was observed within the study area during the site inspection: the *Wildlife Conservation Act 1950* Schedule 2 and *Environment Protection and Biodiversity Conservation Act 1999* Endangered species Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*). A likelihood of occurrence assessment determined that another three conservation significant species are likely to occur within the study area: Baudin's Cockatoo (*Calyptorhynchus baudinii*), Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) and Rainbow Bee-eater (*Merops ornatus*).

The study area contains vegetation which represents high to moderate quality foraging and/or breeding habitat for the conservation significant Black Cockatoos (Carnaby's Black Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Cockatoo). Areas of high quality foraging habitat cover approximately 43.51 ha (64.3%) of the study area while areas of moderate quality foraging habitat cover 12.79 ha (18.9%). High quality breeding habitat covers approximately 10.87 ha (16.1%) of the study area and moderate quality breeding habitat covers 1.06 ha (1.6%).

Approximately 31 hectares of the study area is a mapped wetland however this wetland has been assigned a management category of 'Multiple Use', which is a wetland possessing few remaining important attributes and functions, except for local hydrological function.

1 Introduction

Eco Logical Australia (ELA) was engaged by S2V Consulting (S2V) to undertake a desktop study and site inspection of an area (study area) associated with a potential future spine road that may be utilised to provide access to a proposed industrial facility in the Kemerton Industrial Area, north of Bunbury, south-west WA. The purpose of this work was to develop a stand-alone report encompassing existing biological data and information, which has been ground-truthed as far as practicable from site inspection, to support approvals documentation for development of the access road/s.

The tasks involved for these works were:

- A desktop study utilising previous studies and data from the Kemerton Industrial Area to extract and describe known flora, vegetation and fauna values and characteristics that occur on site;
- A site inspection to validate existing data; and
- Preparation of a stand-alone summary report detailing the outcomes of the desktop study and site inspection, including all relevant figures, describing the known and potential environmental values of the site with the purpose of being attached to any future State or Commonwealth referrals.

1.1 Study area

The study area is approximately 22 kilometres (km) north of Bunbury, Western Australia and is within the Kemerton Industrial Area (**Figure 1**). The study area comprises approximately 70.67 hectares (ha) with Marriott Road bisecting the southern side of the study area (**Figure 1**).

1.2 Climate

The study area is in the Perth subregion of the Swan Coastal Plain Interim Biogeographical Regionalisation for Australia (IBRA) Bioregion, which experiences a warm, Mediterranean climate with hot dry summers and mild wet winters (Mitchell et al. 2002). Based on climate data from the nearby Bureau of Meteorology (BoM) Brunswick Junction Weather Station (Station number 9513, rainfall data 1909 – current, approximately 10 km east of the study area), the study area has received a total of 135.6 millimetres (mm) of rainfall in the three months prior to the site inspection in July 2017, which is below the annual average rainfall of 387.0 mm for the same period (BoM 2017).

Based on climate data from the nearby BoM Bunbury Weather Station (Station number 9965, temperature data 1995 – current, approximately 27 km southwest of the study area), mean monthly maximum temperatures in the area range from 17.3 °C in July to 30.1 °C in February, and mean monthly minimum temperatures range from 7 °C in July to 15.9 °C in February (BoM 2017).

1.3 Regional context

The study area is within the Perth sub-region of the Swan Coastal Plain IBRA Bioregion. It lies over Bassendean Sands soil landscape system (**Table 1**).

Vegetation of the Swan Coastal Plain has been mapped and described by Heddle et al. (1980) as 'vegetation complexes', which represents the structural and floristic description linked to geomorphology (Environmental Protection Authority [EPA] 2016). The vegetation of the study area is representative of the Bassendean complex – central and south of which there is 26.1% of its pre-European extent remaining on the Swan Coastal Plain is (EPA 2015).

Table 1: Existing environmental regional attributes of the study area

Existing environmental attributes	Study area
Interim Biogeographical Regionalisation for Australia (IBRA) Bioregion*	Swan Coastal Plain
IBRA Subregion*	Perth (SWA2)
Soil landscape system**	Bassendean Sands
Beard vegetation association	1000
Vegetation complex^	Bassendean complex – central and south

* Department of the Environment and Energy [DotEE] 2017a

**Government of Western Australia 2000

^Hedde et al. 1980

Vegetation type and extent has also been mapped at a broader regional scale by Beard (1975) who categorised vegetation into broad vegetation associations. Based on Beard's (1975) mapping at a scale of 1:1,000,000, the Department of Agriculture and Food Western Australia has compiled a list of the types and extent of vegetation associations across WA (Shepherd et al. 2002). The vegetation of the site is considered a remnant of the Beard vegetation association 1000 of which there is 25.1% of its pre-European extent remaining on the Swan Coastal Plain (Government of Western Australia 2016).

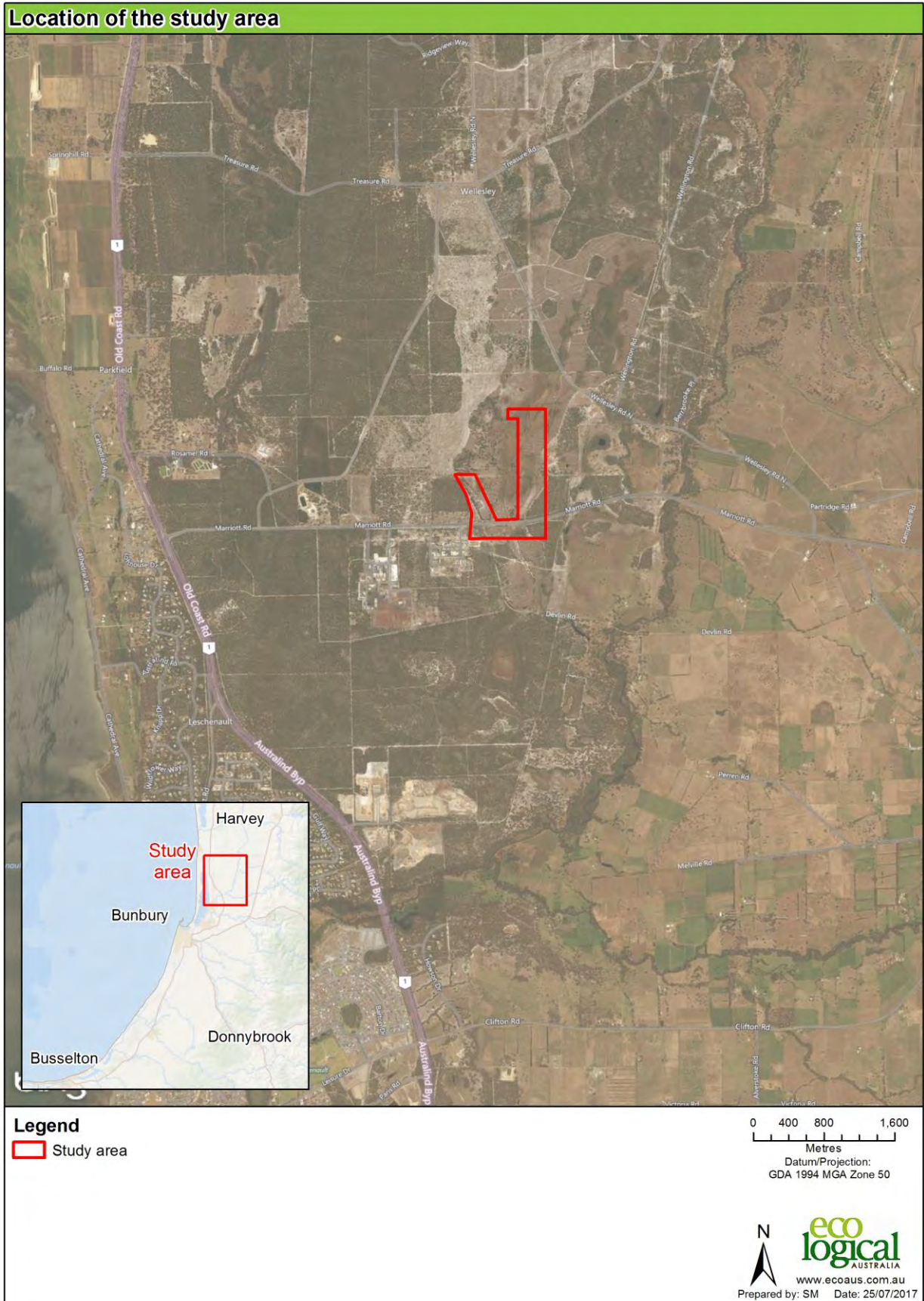


Figure 1: Location of the study area

2 Methodology

2.1 Desktop assessment and literature review

The primary source of information for the desktop review is the report *Targeted Ecological Surveys for Kemerton Industrial Park* (ELA 2014). This report provides a compilation of all existing ecological data and results for studies undertaken within the Kemerton Industrial Area and also includes the study area. This report also includes the results of further surveys undertaken to assist in determining relationships between vegetation communities mapped and defined in previous investigations and fill knowledge gaps. Additionally, the report titled *Desktop Assessment of Selected Lots within Kemerton Industrial Area* (ELA 2017) is also fundamental to the current desktop assessment as it provides ecological information relevant to the proposed industrial facility development area which the current study area is adjacent to.

Methods and results of the desktop assessment and literature review, and comparisons of vegetation communities mapped by previous investigations, specific to the study area are outlined in the following sections.

2.1.1 Previous studies relevant to the study area

Reports and datasets pertaining to the Kemerton Industrial Area which were reviewed and consolidated in ELA (2014) included the following:

- AECOM (2012) '*Kemerton Industrial Park: Threatened Orchid Survey*'
- Bamford Consulting (2011) '*Black Cockatoo and Western Ringtail Possum Habitat Assessment, Kemerton Industrial Park, Bunbury*'
- Cardno (2010a) '*Kemerton Industrial Core: Flora and Vegetation Survey*'
- Cardno (2010b) '*Kemerton Industrial Core: Fauna Survey*'
- Coffey Environments (2007) '*Kemerton Industrial Park Environmental Overview for the KIP Strategy Plan*'
- Coffey Environments (2008) '*Flora, Vegetation, Wetlands and Fauna Assessment Kemerton Industrial Park*'
- Mattiske Consulting (2011a) '*EPBC Act Significance Criteria Review of the Proposed Kemerton Industrial Park Development*'
- Mattiske Consulting (2011b) '*EPBC Act Significance Test of the Proposed Subdivision of 510 Marriott Road, Kemerton*'
- Muir Environmental (1999a) '*Report of Biological Survey – Phase 1: Kemerton Industrial Estate Volume 1 Report*'
- Muir Environmental (1999b) '*Summary Report – Kemerton Industrial Area Phase 1 Biological Survey*'
- Paul Armstrong and Associates (1999a) '*Kemerton Industrial Estate (Original Core Zone) Spring 1999 Rare Flora Search*'
- Paul Armstrong and Associates (1999b) '*Kemerton Industrial Estate (Expanded Core Zone) Mid- and Late Spring 1999 Rare Flora Search*'
- Paul Armstrong and Associates (1999c) '*Kemerton Industrial Estate (Support Industry Area) Mid- and Late Spring 1999 Rare Flora Search*'
- Paul Armstrong and Associates (2007) '*Review of Vegetation Types Monitored within the Kemerton Industrial Estate and Identification of Deficiencies.*'

Vegetation mapping available for the Kemerton Industrial Park consolidated in ELA (2014) included:

- Vegetation mapping by Muir (1999c) which covers the whole of Kemerton Industrial Park

- Vegetation mapping by Coffey (2008) which covers part of the core within Kemerton Industrial Park
- Vegetation mapping by Cardno (2010a) which covers the core of Kemerton Industrial Park
- Vegetation condition mapping by Mattiske (2011c) which covers the whole of Kemerton Industrial Park
- Heddle et al. (1980) vegetation complex mapping which covers the whole of Kemerton Industrial Park
- Geomorphic Wetlands Swan Coastal Plain dataset (Department of Environment and Conservation [DEC] 2013a)

Additionally, the report *Desktop Assessment of Selected Lots within Kemerton Industrial Area* (ELA 2017) was also used in preparation of the current report as it provides specific and updated ecological information for the area adjacent to the current study area.

2.1.2 Database searches

The following Commonwealth and State databases were searched for information relating to conservation listed flora, fauna and ecological communities, to compile and summarise existing data to inform the field inspection. **Table 2** presents the database searches undertaken around the central coordinate (385021m E, 6324759m N)

Table 2: Database searches

Database	Reference	Buffer (km)
Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act	DotEE 2017b	10
NatureMap online flora and fauna database	Parks and Wildlife 2007 - 2017	10
Threatened Flora listed under the latest WA Wildlife Conservation (Rare Flora) Notice and Priority listed flora ¹ , acquired by Landcorp in December 2012	DEC 2012	n/a
Threatened Ecological Communities database search, acquired by Landcorp in January, 2013	DEC 2013b	n/a

¹As of 1 July 2013, the DEC was renamed the Department of Parks and Wildlife (Parks and Wildlife). As data searches were obtained by LandCorp from DEC prior to 1 July 2013, and/or mapping was undertaken prior to the change to Parks and Wildlife, references to searches/mapping are made to DEC.

2.1.3 Likelihood of occurrence assessment

Conservation listed flora and fauna species that possibly occur within the survey area were identified from a review of key datasets and literature. An assessment of the likelihood of occurrence of conservation

listed flora and fauna was made using existing species records from the database searches and the results of the site inspection.

The following criteria was used:

- Known to occur: Recorded from the study area, through database search results and/or from previous surveys of the study area (<20 years)
- Likely to occur: The study area is within the species current distribution and contains suitable habitat for the species, however;
 - The species utilises seasonal habitat or has a large home range, so is not always present/visible in the study area; and/or
 - Survey limitations identified.
- Potential to occur: The study area is within the species current distribution and contains habitat, however (at least two of below);
 - The study area is located on the edge of the species range or it has a patchy distribution; and/or
 - Survey limitations identified; and/or
 - Habitat is less suitable; and/or
 - Species is cryptic, and/or difficult to record utilising traditional survey methods.
- Unlikely to occur: The study area is within the species current distribution and either:
 - contains habitat, was adequately surveyed (including for seasonal, migratory and cryptic species and fauna species with large home ranges) and did not record the species; or
 - the habitat is modified and unlikely to support the species and survey limitations identified.
- Does not occur: The study area is within the species current distribution, and was adequately surveyed (including for seasonal, migratory and cryptic species and fauna species with large home ranges) and did not record the species. The study area may not contain suitable habitat. There is certainty that the species is not present in the study area.

2.2 Site inspection

A site inspection was conducted on the 6 July 2017 by ELA Ecology Manager/Senior Botanist Joel Collins, to ground truth values identified in previous surveys and update this information where required. This included assessment of vegetation communities, previously recorded conservation significant flora, and identification of any suitable habitat for conservation listed flora and fauna species.

3 Results

3.1 Flora

Cardno (2010a) recorded 324 native species and 74 introduced (weed) species from 61 families and 178 genera, across the broader Kemerton Industrial Area inner core, representing an area of approximately 2,500 ha. The top three most dominant families were Orchidaceae (43 native, 1 weed taxon), Fabaceae (29 native, 9 weed taxa) and Myrtaceae (23 native taxa, no weed taxon). The three most common genera were *Acacia* (15 species), *Caladenia* (13 species) and *Lomandra* (11 species). One survey site from the Cardno (2010a) study falls within the study area. Cardno (2010a) recorded 27 species at this survey site, from 16 families and 22 genera. The most common families were Fabaceae (5 taxa) and Proteaceae (4 taxa) and the most common genera were *Acacia* (3 taxa) and *Banksia* (3 taxa).

During the 2017 site inspection, 20 dominant species were recorded comprising 10 families and 17 genera. The most common family was Myrtaceae with 8 taxa and the most common genera was *Banksia*, *Eucalyptus* and *Juncus* with two taxa each.

Of the 74 weed species recorded by Cardno (2010a), two species are listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007*. These species include: **Gomphocarpus fruticosus* (Narrow Leaf Cotton Bush) and **Zantedeschia aethiopica* (Arum Lily). These species were not recorded during the recent site visit, however, are still considered to potentially occur based on previous survey data.

Common weed species observed within the study area during the site inspection included **Ehrharta calycina* (Perennial Veldt Grass), **Cynodon dactylon* (Couch) and **Eragrostis curvula* (African Lovegrass). In particular, **Cynodon dactylon* (Couch) is widespread in highly disturbed/cleared damp low lying areas of the study area.

3.1.1 Conservation significant flora

Two conservation significant flora species, *Acacia semitrullata* (Priority 4) and *Caladenia speciosa* (Priority 4) have been previously recorded within the study area.

Acacia semitrullata (Priority 4) has been recorded at one location in the south-east corner of the study area (LandCorp dataset; **Figure 2**). This species was observed during the site inspection throughout areas of remnant vegetation in the southern parts of the study area.

Caladenia speciosa (Priority 4) was noted by Coffey (2008) to occur throughout remnant vegetation in the south-eastern portion of the study area. This species was not observed during the site inspection however areas of remnant vegetation of high quality and not subject to significant disturbances, were considered suitable to support this species. Remaining areas of the study area, particularly where there are historical disturbances from clearing and agricultural practices are considered unlikely to support these species.

The database searches identified an additional 31 flora species of conservation significance which may occur within the study area. A likelihood of occurrence assessment (**Appendix A**) undertaken for these species against criteria outlined in section 2.1.3 has determined that of those 31 additional species, 14 have the potential (albeit not such that they are considered 'likely') to occur within the study area noting that the site has now been subject to repeated survey effort over time and they have not been recorded to date:

- *Acacia flagelliformis* (Parks and Wildlife Priority 4)

- *Boronia juncea* subsp. *juncea* (Parks and Wildlife Priority 1)
- *Caladenia huegelii* (EPBC Act Endangered; *Wildlife Conservation Act 1950* [WC Act] Threatened)
- *Dillwynia dillwynioides* (Parks and Wildlife Priority 3)
- *Diuris drummondii* (WC Act Threatened)
- *Diuris micrantha* (EPBC Act Vulnerable; WC Act Threatened)
- *Diuris purdiei* (EPBC Act Endangered; WC Act Threatened)
- *Drakaea elastica* (EPBC Act Endangered; WC Act Threatened)
- *Drakaea micrantha* (EPBC Act Vulnerable; WC Act Threatened)
- *Microtis quadrata* (Parks and Wildlife Priority 4)
- *Pterostylis frenchii* (Parks and Wildlife Priority 2)
- *Pultenaea skinneri* (Parks and Wildlife Priority 4)
- *Tripterooccus* sp. *Brachylobus* (A.S. George 14234; Parks and Wildlife Priority 4)
- *Verticordia attenuata* (Parks and Wildlife Priority 3).

Habitat for species considered as having the potential to occur comprises areas of intact remnant vegetation located in the south east and south western portions of the study area. Remaining areas of the study area are considered unlikely to support any conservation significant flora species. This is due to historical disturbances in these areas such as clearing, grazing and plantations which has significantly altered the structure of native vegetation and resulted in low condition.

The remaining 17 taxa are considered unlikely to occur within any part of the study area.

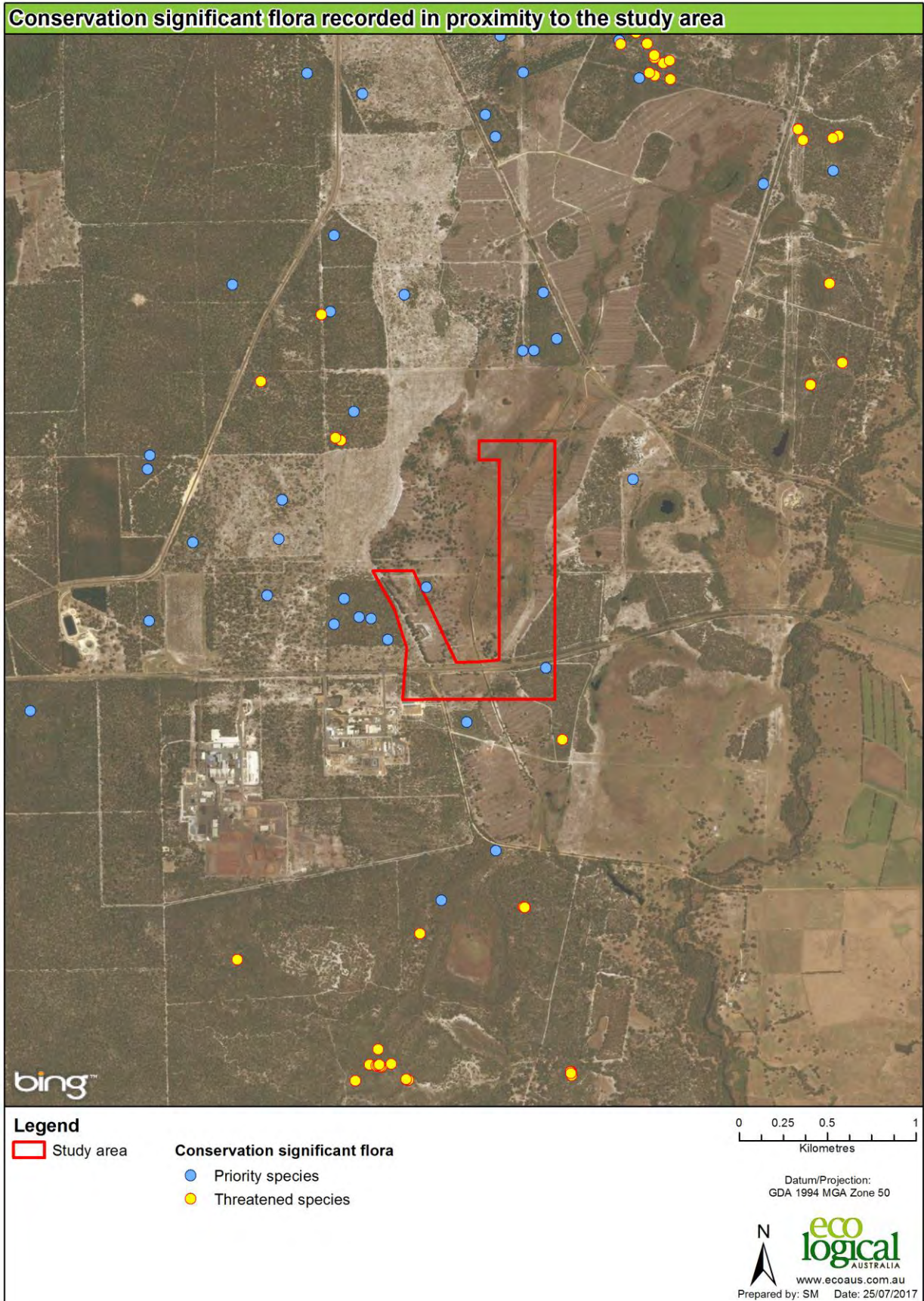


Figure 2: Conservation significant flora recorded in proximity to the study area

3.2 Vegetation

3.2.1 Vegetation communities



The most recent vegetation mapping undertaken at Kemerton (Cardno 2010a and updated by ELA 2014) described one vegetation community as dominating the study area: EmCcBa. There is also a small area (0.2 ha) of vegetation community BaBiKg. The remaining portions of the study area were mapped by Cardno (2010a) as cleared paddocks, plantations and existing infrastructure or cleared mining areas.



As part of the site inspection, the Cardno (2010a) and ELA (2014) vegetation mapping was reviewed and refined and mapping and descriptions updated where applicable. Following this review, the vegetation of the study area is considered to support eight vegetation communities with some differences to vegetation communities that were previously mapped by Cardno (2010a) and updated by ELA (2014; **Table 3**). Specifically, the following was noted during the site inspection:



- A number of additional vegetation communities were described that were not noted in previous studies including remnant vegetation in areas previously mapped as plantations and cleared paddocks. This is understandable as the previous vegetation mapping undertaken over the study area was at a broader scale. The current report has identified these local scale vegetation communities and updated vegetation descriptions and mapping where applicable (**Table 3** and **Figure 3**)
- Vegetation described in the adjacent area by ELA (2017) is analogous to some vegetation communities inspected in the survey for the current report and are continuous across both study areas. The description of each vegetation community may not, however, be entirely consistent across both reports; this is due to the slight variation in dominant species cover and composition at the different sample sites from which the descriptions are derived. This is of particular note between vegetation communities PJP and EmCcXb from ELA (2017) and vegetation communities ErMpJk and CcBaKgXb from the current survey respectively. However for the purpose of assessment, they are considered to be the same vegetation community defined at the local scale.



Mapping of vegetation communities that were described during the site inspection is presented in **Figure 3**.

Table 3: Vegetation communities within the study area confirmed during the site inspection

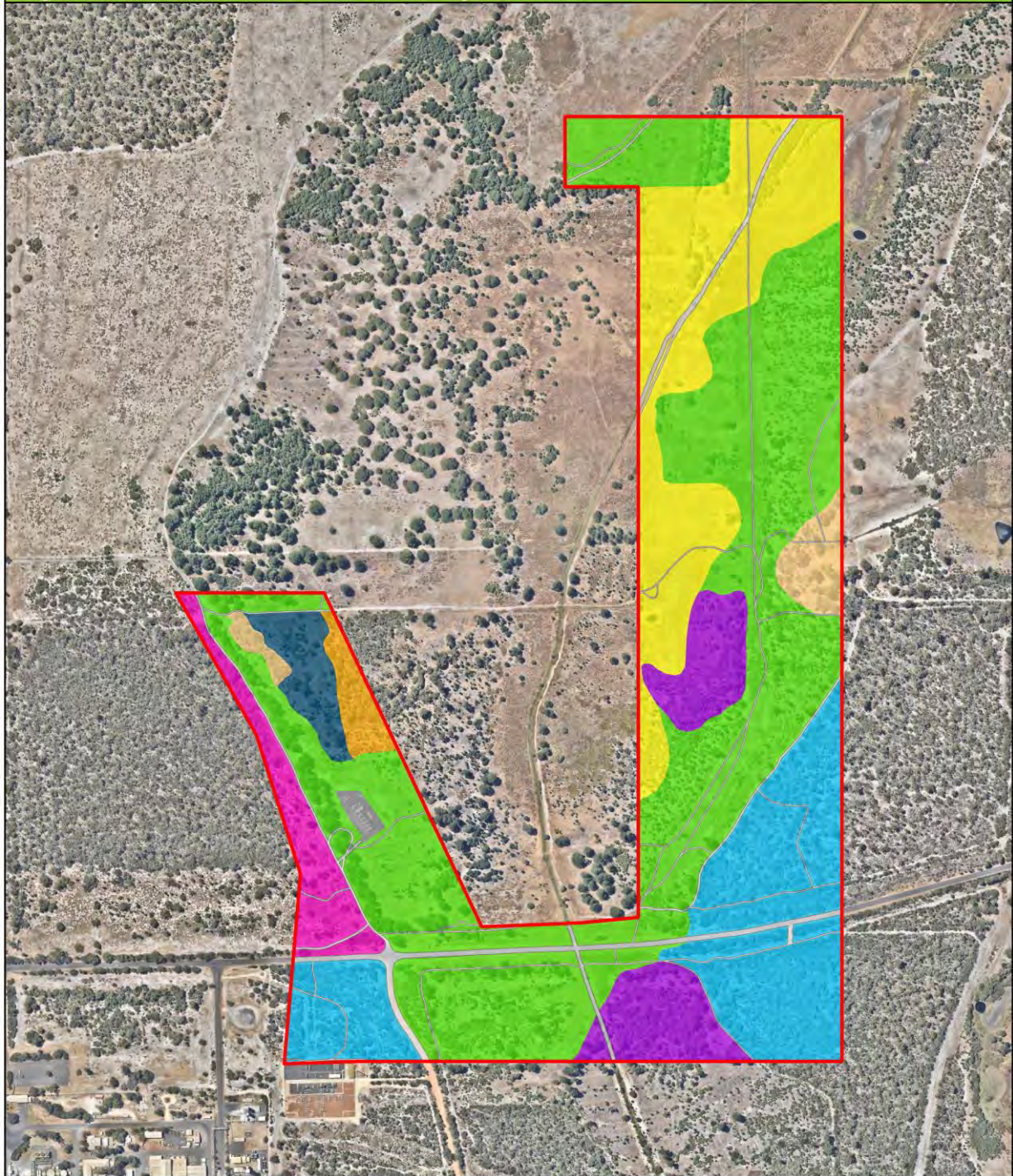
Vegetation community	Description	Condition	Approximate extent within the study area	Photo
CcKg	<i>Corymbia calophylla</i> closed forest over <i>Kunzea glabrescens</i> tall open shrubland over <i>Astartea scoparia</i> and <i>Xanthorrhoea brunonis</i> open shrubland over <i>Hypocalymma angustifolium</i> low open shrubland over <i>Juncus pallidus</i> isolated clumps of rushes	Good	1.67 ha (2.47%)	
MpAs	<i>Melaleuca preissiana</i> low woodland over <i>Astartea scoparia</i> tall open shrubland over <i>Juncus pallidus</i> isolated clumps of rushes	Completely Degraded	1.69 ha (2.48%)	

Vegetation community	Description	Condition	Approximate extent within the study area	Photo
CcBaKgXb	<p><i>Corymbia calophylla</i> open woodland over <i>Banksia attenuata</i>, <i>Banksia ilicifolia</i> and <i>Melaleuca preissiana</i> low open woodland over <i>Kunzea glabrescens</i> tall sparse shrubland over <i>Xanthorrhoea brunonis</i> low open shrubland over <i>Dasypogon bromeliifolius</i> open forbland</p>	Very Good	1.06 ha (1.57%)	
EmBiKgAs	<p><i>Eucalyptus marginata</i> subsp. <i>marginata</i>, <i>Agonis flexuosa</i> and <i>Banksia attenuata</i> woodland over <i>Banksia ilicifolia</i> low open woodland over <i>Kunzea glabrescens</i> and <i>Jacksonia sternbergiana</i> tall sparse shrubland over <i>Acacia semitrullata</i> (P4), <i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i> and <i>Xanthorrhoea brunonis</i> sparse shrubland over <i>Dasypogon bromeliifolius</i> sparse forbland</p>	Good - Excellent	11.81 ha (17.44 %)	

Vegetation community	Description	Condition	Approximate extent within the study area	Photo
PEr	<i>Pinus radiata</i> and <i>Eucalyptus rudis</i> low open woodland in low lying seasonal dampland	Completely Degraded	31.62 ha (46.71%)	
ErMpKg	<i>Eucalyptus rudis</i> woodland over <i>Melaleuca preissiana</i> and <i>Pinus radiata</i> low open woodland over <i>Kunzea glabrescens</i> tall sparse shrubland	Good – Completely Degraded	4.84 ha (7.14%)	

Vegetation community	Description	Condition	Approximate extent within the study area	Photo
ErMpJk	<i>Eucalyptus rudis</i> isolated trees over <i>Melaleuca preissiana</i> and <i>Pinus radiata</i> low open woodland over <i>Juncus kraussii</i> subsp. <i>australiensis</i> and <i>Juncus pallidus</i> sedgeland over * <i>Cynodon dactylon</i> very open grassland in low lying seasonal dampland	Completely Degraded	11.87 ha (17.54 %)	
EmKgMr	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> and <i>Banksia ilicifolia</i> low open woodland over <i>Kunzea glabrescens</i> tall sparse shrubland over <i>Macrozamia riedlei</i> and <i>Xanthorrhoea brunonis</i> shrubland	Completely Degraded - Excellent	2.83 ha (4.18%)	

Vegetation communities within the study area



<p>Legend</p> <ul style="list-style-type: none"> Study area Track / infrastructure Infrastructure <p>Vegetation community</p> <ul style="list-style-type: none"> CcBaKgXb: <i>Corymbia calophylla</i> open woodland over <i>Banksia</i> spp. and <i>Melaleuca preissiana</i> low open woodland over <i>Kunzea glabrescens</i> and <i>Xanthorrhoea brunonis</i> open shrubland over <i>Dasyopogon bromeliifolius</i> open forbland CcKg: <i>Corymbia calophylla</i> closed forest over open shrubland of mixed myrtaceous shrubs and <i>Xanthorrhoea brunonis</i> over <i>Juncus pallidus</i> isolated clumps of rushes EmBkKgAs: <i>Eucalyptus marginata</i> subsp. <i>marginata</i>, <i>Agonis flexuosa</i> and <i>Banksia attenuata</i> woodland over mixed sparse shrubland over <i>Dasyopogon bromeliifolius</i> sparse forbland EmKgMr: <i>Eucalyptus marginata</i> subsp. <i>marginata</i> and <i>Banksia ilicifolia</i> low open woodland over <i>Kunzea glabrescens</i> tall sparse shrubland over <i>Macrozamia rediei</i> and <i>Xanthorrhoea brunonis</i> shrubland ErMpJk: <i>Eucalyptus rudis</i> isolated trees over <i>Melaleuca preissiana</i> and <i>Pinus radiata</i> low open woodland over <i>Juncus</i> spp. sedgeland over *<i>Cynodon dactylon</i> vary open grassland ErMpKg: <i>Eucalyptus rudis</i> woodland over <i>Melaleuca preissiana</i> and <i>Pinus radiata</i> low open woodland over <i>Kunzea glabrescens</i> tall sparse shrubland MpAs: <i>Melaleuca preissiana</i> low woodland over <i>Astartea scoparia</i> tall open shrubland over <i>Juncus pallidus</i> isolated clumps of rushes PEr: <i>Pinus radiata</i> and <i>Eucalyptus rudis</i> low open woodland in low lying seasonal dampland 		<p>0 75 150 300</p> <p>Metres</p> <p>Datum/Projection: GDA 1994 MGA Zone 50</p> <p> eco logical AUSTRALIA www.ecoaus.com.au</p> <p>Prepared by: SM Date: 08/08/2017</p>
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Figure 3: Vegetation communities within the study area as mapped and described in July 2017 during the site inspection

3.2.2 Threatened and Priority Ecological Communities

Previous surveys (Cardno 2010a and Coffey 2008) that included the study area found vegetation communities closely resembling Floristic Community Type (FCT) 21c. This FCT is listed by Parks and Wildlife as the Priority Ecological Community (PEC) 'Low lying *Banksia attenuata* woodlands or shrublands' (Priority 3; Department of Biodiversity, Conservation and Attractions [DBCA] 2017). In the study undertaken by Cardno (2010a) and updated by ELA (2014), which is the most recent vegetation mapping of the study area to date, this PEC is represented by the vegetation community EmCcBa and BaBiKg and is present in the south-east and western portions of the study area as discrete patches. Statistical analysis undertaken by Cardno (2010a) found quadrats (one of which occurs within the current study area), within vegetation communities EmCcBa and BaBiKg, most closely aligned to FCT21c. This PEC is not currently recognised by Parks and Wildlife as occurring within the study area, with the closest mapped occurrence located approximately 2 km to the south-west (DEC 2013b).

Since previous studies were undertaken, the TEC, 'Banksia Woodlands of the Swan Coastal Plain' has been listed as Endangered under the EPBC Act (Department of the Environment and Energy [DotEE] 2016). To determine whether the Banksia Woodlands of the Swan Coastal Plain TEC is present in the study area, key diagnostic characteristics must be met under Section 2 of the Conservation Advice on the DotEE Species Profile and Threats Database (DotEE 2016).

Following the steps provided in the Conservation Advice administered by the Commonwealth government, the vegetation communities described during the site inspection as CcBaKgXb, EmBiKgAs and EmKgMr are considered to represent the EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' TEC as they meet the relevant guideline criteria (DotEE 2016; **Figure 3**).

These vegetation communities coincide with vegetation that has also been previously determined to align with FCT 21c (Coffey 2008; Cardno 2010a); FCT 21c is listed as a community which has a relationship to the TEC. Vegetation communities CcBaKgXb, EmBiKgAs and EmKgMr occur in the south eastern and western parts of the study area and portions in Good or better condition cover 15.12 ha (21.4%) of the study area (**Table 3, Figure 3**).

Vegetation communities CcBaKgXb and EmKgMr also adjoin vegetation assessed as representing this TEC in the ELA (2017) study.

There are no other State or Commonwealth listed TECs inferred to be present within the study area.

3.2.3 Vegetation condition

Based on ground truthing during the site inspection, the condition of native vegetation within the study area ranges from Excellent to Completely Degraded (**Figure 4**).

The most intact areas of native vegetation with the highest quality are in the south east corner and along the western edge of the study area. These areas of vegetation are mostly in Excellent (9.83 ha; 14.52% of study area), Very Good (1.79 ha; 2.65% of study area) and Good (7.74 ha; 11.43% of study area) condition. The remaining areas of the study area are in Completely Degraded condition (47.91 ha, 70.78% of the study area) and Degraded condition (0.11 ha, 0.17% of the study area). Areas with lower condition were experiencing disturbances such as previous clearing/logging, rubbish dumping proliferation of tracks, illegal fire wood harvesting, illegal access by 4WD and motor bikes, grazing (cattle and pigs), edge effects and weeds.

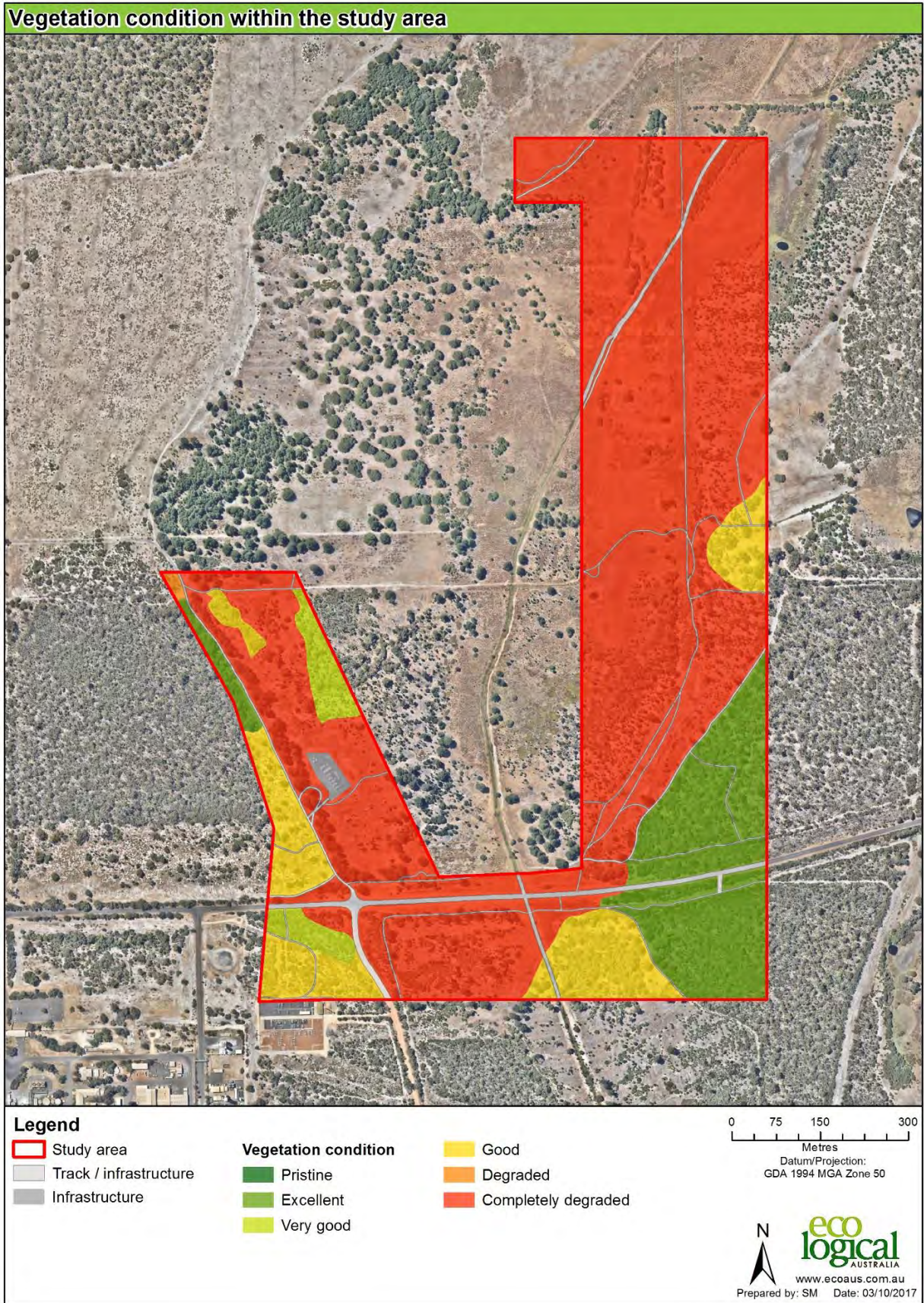


Figure 4: Vegetation condition within the study area, as mapped and described in July 2017 during the site inspection

3.3 Fauna

In the Cardno (2010b) survey of the broader Kemerton Industrial Area inner core, 103 species of vertebrate fauna were recorded. This included 56 native bird species (one introduced), 15 native (five introduced) mammal species, 21 reptiles and five amphibians, representing an area of approximately 2,500 ha. Results returned from a search of the NatureMap database (Parks and Wildlife 2007 – 2017), with a 5 km buffer, included a total of 147 vertebrate fauna species, comprising 110 native bird species, 10 native mammals, 20 reptiles and seven amphibians.

3.3.1 Conservation significant fauna

One conservation significant species was observed within the study area during the site inspection: the WC Act Schedule 2 and EPBC Act Endangered species Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*).

The database searches identified an additional 49 fauna species of conservation significance which may occur within the study area. A likelihood of occurrence assessment (**Appendix A**) undertaken for these species against criteria outlined in section 2.1.3 has determined that another three species are likely to occur within the study area: the WC Act Schedule 2 and EPBC Act Vulnerable species Baudin's Cockatoo (*Calyptorhynchus baudinii*), WC Act Schedule 3 and EPBC Act Vulnerable species Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) and WC Act Schedule 5 and EPBC Act Migratory species Rainbow Bee-eater (*Merops ornatus*).

In addition to the species assessed as likely to occur, a further eight have the potential to occur within the study area:

- *Ardea ibis* (Cattle Egret; EPBC Act Migratory, WC Act Schedule 5)
- *Ardea modesta* (Eastern Great Egret; WC Act Schedule 5)
- *Dasyurus geoffroyi* (Chuditch; EPBC Act Vulnerable, WC Act Schedule 3)
- *Falco peregrinus* (Peregrine Falcon; WC Act Schedule 7)
- *Isoodon obesulus* subsp. *fusciventer* (Quenda; Parks and Wildlife Priority 4)
- *Lerista lineata* (Perth Slider; Parks and Wildlife Priority 3)
- *Macropus irma* (Western Brush Wallaby; Parks and Wildlife Priority 4)
- *Pseudocheirus occidentalis* (Western Ringtail Possum; EPBC Act Vulnerable, WC Act Schedule 1)

The remaining 38 species are considered unlikely to occur in or around the study area.

3.3.2 Fauna habitats

Broad fauna habitats previously identified in the fauna survey by Cardno (2010b) and as reviewed in ELA (2014) include the following habitat types within the study area:

- Woodland to low forest of *Banksia attenuata*, *Banksia ilicifolia*, and *Eucalyptus marginata* over tall shrubland of *Kunzea glabrescens* over shrubland to very open shrubland on lower slopes to flats on grey sand;
- Plantations of Blue Gums (*Eucalyptus globulus*) and Pines (*Pinus pinaster*); and
- Cleared paddocks and areas of existing infrastructure.

The site inspection investigated the presence of these habitats and refined the habitat descriptions and boundaries to reflect current conditions within the study area (**Figure 5**). As a result, the following broad fauna habitats are considered to occur within the study area:

- *Eucalyptus/Banksia* Woodland: Woodland of Jarrah (*Eucalyptus marginata* subsp. *marginata*) and Marri (*Corymbia calophylla*) with *Banksia attenuata* and *Banksia ilicifolia* low open woodland over *Xanthorrhoea brunonis* shrubland on uplands
- Marri forest: Marri (*Corymbia calophylla*) forest over mixed myrtaceous shrubland and *Xanthorrhoea brunonis* over isolated clumps of rushes on fringes of low lying damp areas
- *Melaleuca* woodland: *Melaleuca preissiana* low woodland and myrtaceous shrubland over isolated clumps of rushes on low lying damp areas
- Woodland over sedgeland: Woodland to low open woodland of Flooded Gum (*Eucalyptus rudis*), *Melaleuca preissiana* and *Pinus radiata* over *Kunzea glabrescens* shrubland and sedgeland of *Juncus spp.* on seasonally inundated areas/damplands
- Pine plantation: *Pinus radiata* and *Eucalyptus rudis* low open woodland in low lying seasonal dampland

ELA (2014) described the suitability of habitats for supporting foraging and breeding by the conservation significant Black Cockatoo species (Carnaby's Black Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Cockatoo) within the Kemerton Industrial Area. The current quality of foraging and breeding habitats within the study was validated or updated where required, against ELA (2014) mapping, during the site inspection (**Figure 6** and **Figure 7**).

Based on the site inspection, the study area contains large areas of high (43.51 ha, 64.3% of study area) and moderate (12.79 ha, 18.9% of study area) quality foraging habitat for the three Black Cockatoo species. Specifically, the vegetation communities in the south-east and western parts of the study area contain Marri, Jarrah and/or *Banksia*, which are primary foraging species for Carnaby's Cockatoo (*Banksia* spp.), Baudin's Cockatoo (Marri) and Forest Red-tailed Black Cockatoo (Jarrah and Marri; Department of Sustainability, Environment, Water, Population and Communities 2012; **Figure 6**). Furthermore, areas of former (with pine tree regrowth or scattered individual trees) pine plantation or where stands of mature pine trees still occur, comprise moderate – high quality foraging habitat for Carnaby's and Baudin's Cockatoos (ELA 2014). Areas of myrtaceous vegetation within the study area were considered to be low quality foraging habitat as these vegetation communities did not contain suitable foraging species for any of the Black Cockatoo species.

The woodland habitats containing large Marri and/or Jarrah trees also provide high quality potential breeding habitat for the Black Cockatoos (ELA 2014). The portions of these woodlands that contain the high quality potential breeding habitat are confined to the eastern edge and the south-west corner of the study area with a small patch also in the north western part of the study area (**Figure 7**). High quality potential breeding habitat covers approximately 10.87 ha (16.1%) of the study area and moderate quality breeding habitat covers 1.06 ha (1.6%).

Previous examination of breeding trees within parts of the study area was undertaken by Coffey (2008) with further evaluation of their use by Bamford Consulting (2011). Four potential breeding trees were recorded in the study area by Coffey (2008) with one of these trees found by Bamford Consulting (2011) to have a hollow > 100 mm in size. It was occupied by bees at the time of this survey and there were no obvious Cockatoo signs of use (Bamford Consulting 2011). This tree is located along the north-western edge of the study area (**Figure 7**). The remaining three trees could not be located during the Bamford (2011) survey; these trees are located in the south western part of the study area.

Fauna habitats within the study area

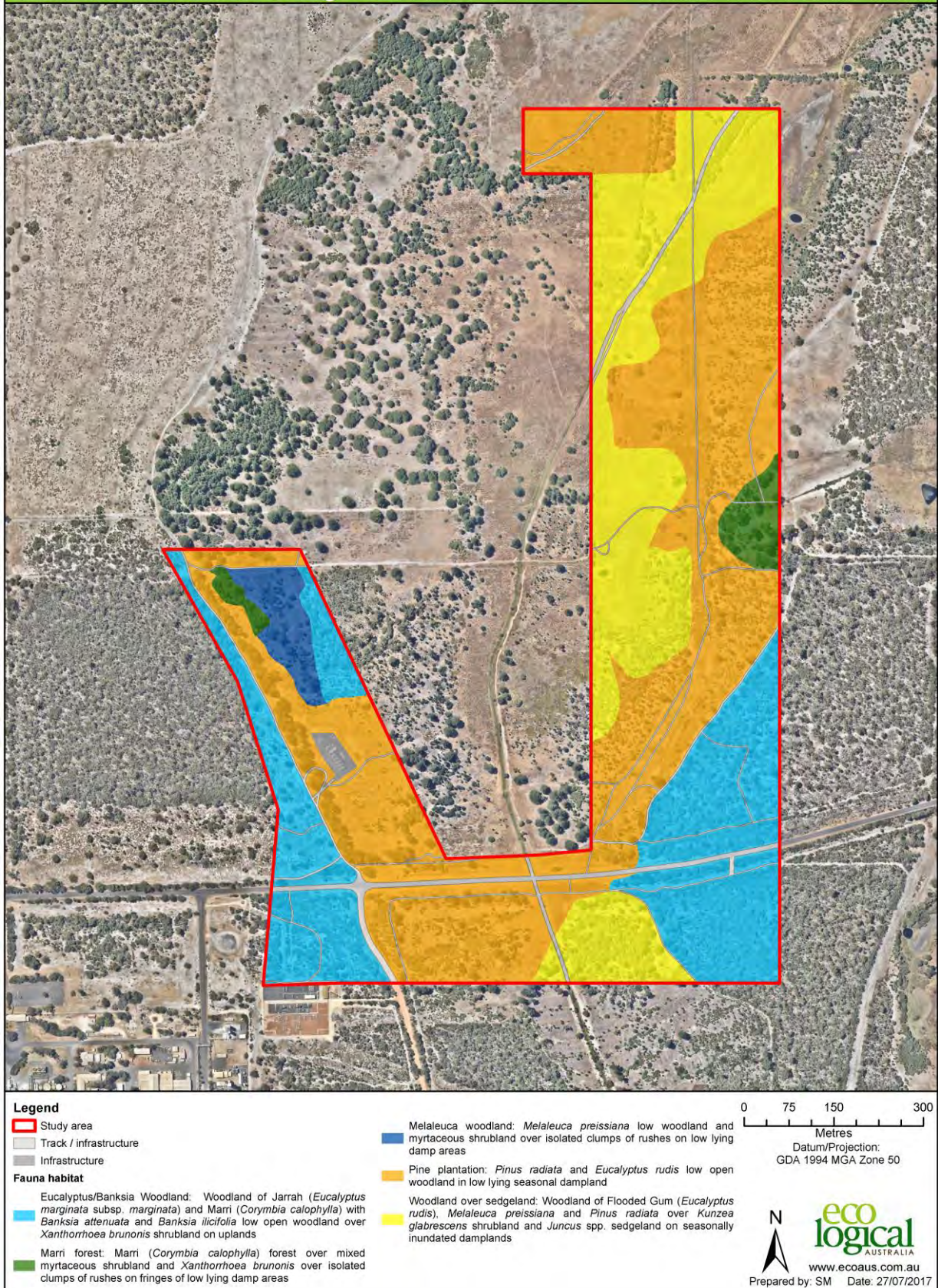


Figure 5: Fauna habitats within the study area, as mapped and described July 2017 during the site inspection

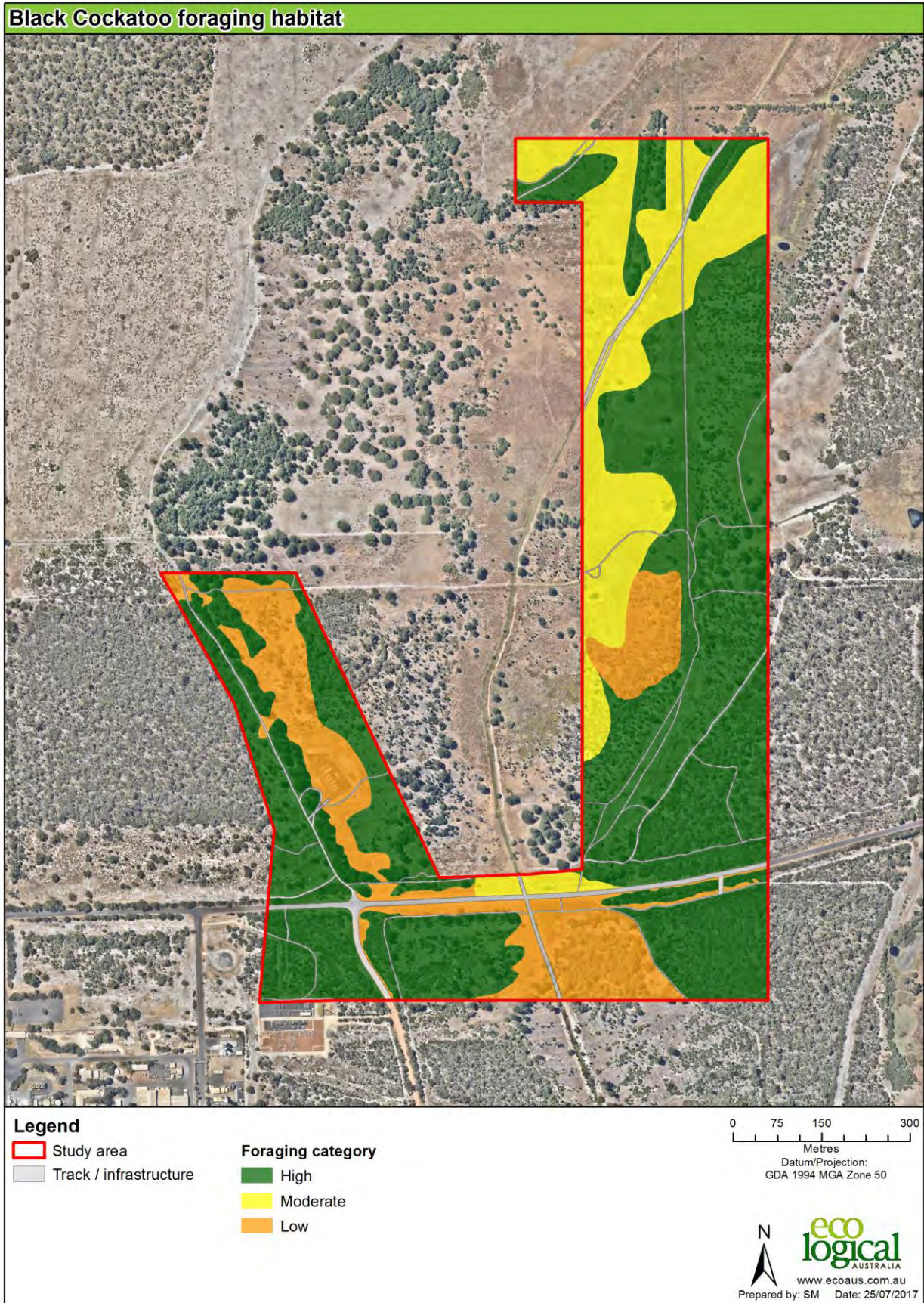


Figure 6: Black Cockatoo foraging habitat as confirmed and/or mapped during the site inspection in July 2017

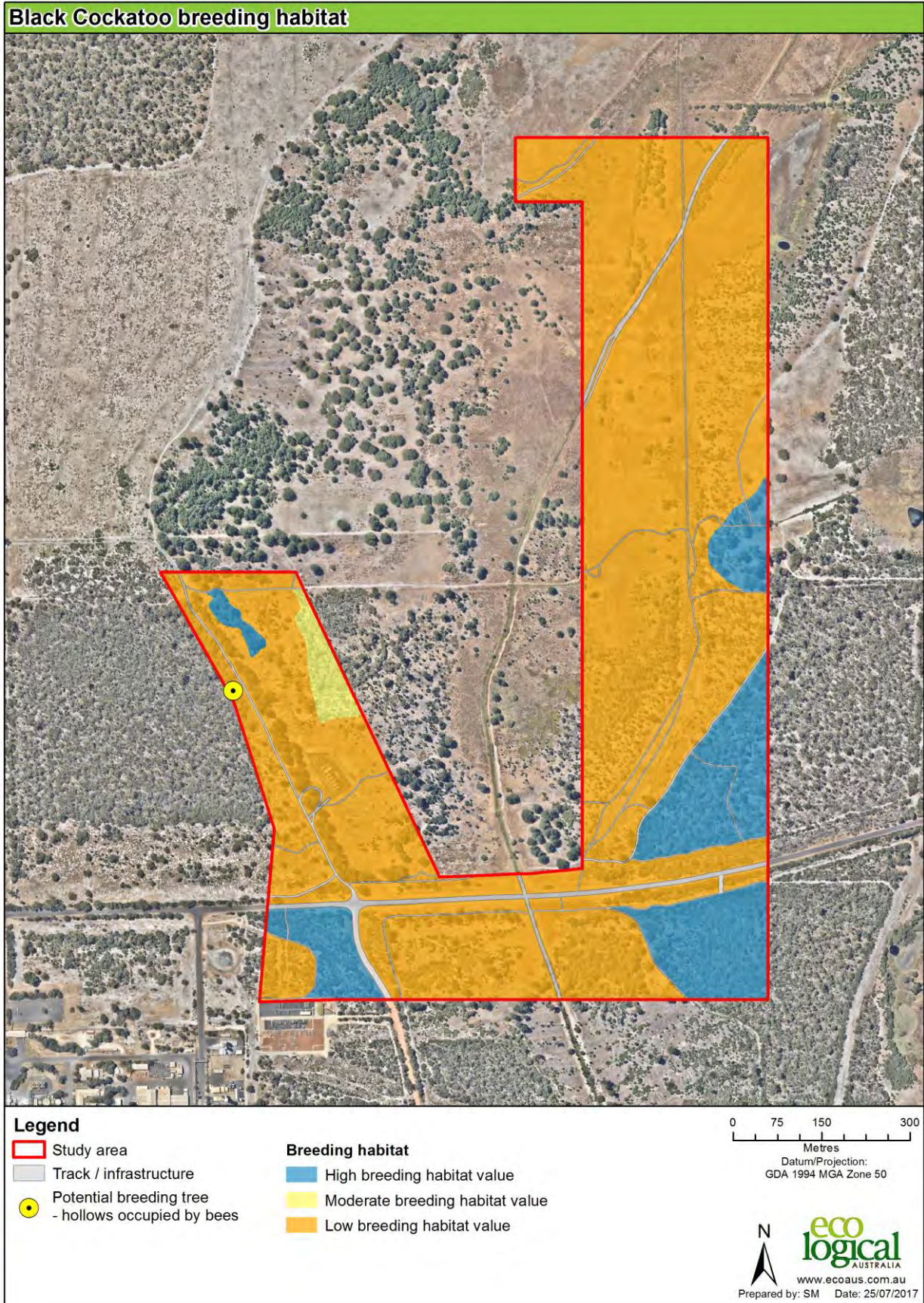


Figure 7: Black Cockatoo breeding habitat, as confirmed and/or mapped during the site inspection in July 2017

The entire study area provides habitat for the Rainbow Bee-eater (*Merops ornatus*), which is considered likely to occur. This species is likely to occur only on a transitional basis utilising the study area opportunistically for foraging. The study area is unlikely to be a significant feeding or breeding site for this species.

3.4 Wetlands

Broad wetland mapping has been coordinated by Parks and Wildlife and included in the Geomorphic Wetlands Swan Coastal Plain dataset (Parks and Wildlife 2016). This dataset contains information on the location, boundaries, classification, management categories and unique feature identifier numbers of wetlands on the Swan Coastal Plain (Parks and Wildlife 2016).

The Geomorphic Wetlands Swan Coastal Plain dataset indicates there are no 'Conservation' or 'Resource Enhancement' management category wetlands in the study area.

A large part, primary in the eastern portion, of the study area, is a mapped wetland. The approximate extent of this mapped wetland within the entire study area is 31 ha, which is made up of several discrete map units. This wetland has been assigned a wetland classification of Sumpland and Dampland with a management category of 'Multiple Use' (Parks and Wildlife 2016). The management category of 'Multiple Use' is defined as 'Wetlands with few remaining important attributes and functions' (Parks and Wildlife 2013). The objective of Multiple Use wetlands is to use, develop and manage the wetland in the context of ecologically sustainable development and best management catchment planning (Parks and Wildlife 2013).

Areas mapped as wetland within the study area have been historically modified through clearing and establishment of pine plantations and the hydrology is currently altered through excavation of an artificial drainage ditch. The wetland area is also almost entirely in Completely Degraded condition and is experiencing disturbances such as weeds, grazing, unauthorised access (e.g. unplanned tracks, firewood collection, motorbikes) and clearing. In its current state, the wetland area offers little to no value apart from hydrological function acting as a conduit for stormwater runoff. On occasions when standing water is present in small areas, it may provide opportunistic foraging opportunities for wetland birds, however it does not form core habitat which any species would be reliant on.

4 Summary and conclusion

Eight vegetation communities were described in the study area during the site inspection. Of these vegetation communities, three (CcBaKgXb, EmBiKgAs and EmKgMr) are considered to represent the EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' TEC as they meet the relevant guideline criteria (DotEE 2016). Previous studies have also found vegetation communities within the study area which closely resemble the PEC 'Low lying *Banksia attenuata* woodlands or shrublands' (Priority 3; DBCA 2017). This PEC is however not currently recognised by Parks and Wildlife as occurring within the study area, with the closest mapped occurrence located approximately 2 km to the south-west (DEC 2013b).

Areas of these vegetation communities which are in Good or better condition with few disturbances, support the conservation significant flora species, *Acacia semitrullata* (Priority 4), which was observed during the site inspection. *Caladenia speciosa* (Priority 4) has also previously been recorded in areas of vegetation community EmBiKgAs in the south-east corner of the study area (Coffey 2008).

All areas of remnant vegetation within the study area, in Good or better condition with few disturbances could also potentially provide habitat for several other conservation significant flora species, many of which are significant at a state and federal level. These species have not been found within the study area in this or any historical surveys.

Remnant vegetation in Good or better condition within the study area is mostly confined to the south-eastern corner and western parts of the study area. Remaining areas of the study area are in Completely Degraded condition.

Vegetation communities containing Jarrah, Marri and/or *Banksia*, described during the site inspection, provide high - moderate quality foraging and/or potential high-moderate quality breeding habitat for the conservation significant fauna species, Black Cockatoos (Carnaby's Black Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Cockatoo). These vegetation communities extend outside of the study area and are widespread in parts of the Kemerton Industrial Area Buffer.

Remaining areas of the study area previously were pine plantation, which has been harvested (with regrowth or isolated trees remaining) or remains as small stands. These areas represent high – moderate quality foraging habitat for the listed threatened Carnaby's Cockatoo and Baudin's Cockatoo.

Approximately 31 ha of the study area is a mapped wetland assigned a management category of 'Multiple Use', which is a wetland possessing few remaining important attributes and functions, except for local hydrological function. Consideration should be given to the implications of draining and/or filling in of the wetland on local hydrology if proposed for development.

A summary of ecological values within the study area is presented in **Table 4**.

Table 4: Summary of ecological values occurring within the study area

Ecological value	Study area
Overview	Remnant vegetation in good or better condition occurs in the south-east and western parts of the study area. This vegetation provides values for conservation significant flora, vegetation and fauna. Comparable vegetation also extends outside of the study area and is widespread in parts of the Kemerton Industrial Area Buffer. Remaining areas of the study area have been historically highly modified and disturbed and no longer have values which support significant species or communities except for some areas of High – moderate foraging habitat for the Carnaby's Cockatoo and Baudin's Cockatoo.
Conservation significant flora	<i>Acacia semitrullata</i> (Priority 4), has been recorded throughout remnant vegetation types in Good or better condition in the south-east and western parts of the study area, both during the site inspection and in surveys undertaken previously which include the study area. <i>Caladenia speciosa</i> (Priority 4) has also been recorded throughout remnant vegetation in the south-east of the study area in previous surveys (Coffey 2008). Vegetation in Good or better condition in the south-east and western parts of the study area also have the potential to support other species of conservation significance, including species which are listed under the EPBC Act and/or WC Act.
Vegetation communities	Eight vegetation communities were recorded during the site inspection. The most extensive is PER: <i>Pinus radiata</i> and <i>Eucalyptus rudis</i> low open woodland in low lying seasonal dampland which covers 46.7% of the study area. This vegetation community is representative of a significantly modified community (from historical activities, as indicated by the dominance of an introduced species, <i>Pinus radiata</i>).
Vegetation condition	Majority of the study area is in Completely Degraded condition (47.91 ha, 70.78%). Remaining areas are in Degraded (0.17 ha, 0.17%), Good (7.74 ha, 11.43%), Very Good (1.79 ha, 2.65%) and Excellent (9.83 ha, 14.52%) condition. These areas in Good or better condition occur in the south-east and western parts of the study area.
Conservation significant vegetation	Some areas of remnant vegetation within the study area have been previously determined to represent the PEC 'Low lying <i>Banksia attenuata</i> woodlands or shrublands' (Priority 3; DBCA 2017). Vegetation communities CcBaKgXb, EmBiKgAs and EmKgMr, described in the site inspection are considered to represent the EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' TEC as they meet the relevant guideline criteria (DotEE 2016). These vegetation communities comprise 15.69 ha (23.2%) of the study area and occur in the south-east and western parts of the study area.
Conservation significant fauna	One conservation significant species has been previously recorded within the study area: the WC Act Schedule 2 and EPBC Act Endangered species Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>). This species was observed during the site inspection for the current report.
Fauna habitats	Five habitats described within the study area during the site inspection for the current report. The most widespread habitat is Pine plantation:

Ecological value	Study area
	<i>Pinus radiata</i> and <i>Eucalyptus rudis</i> low open woodland in low lying seasonal dampland which covers 31.62 ha (46.7%) of the study area.
Habitats to support conservation significant fauna known or likely to occur	Vegetation containing Jarrah, Marri and/or <i>Banksia</i> spp. represent high to moderate quality foraging and/or breeding habitat for the conservation significant Black Cockatoos (Carnaby's Black Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Cockatoo). Areas of pine plantation also provide high - moderate quality foraging habitat for the Carnaby's Cockatoo and Baudin's Cockatoo. Areas of high quality foraging habitat covers approximately 43.51 ha (64.3%) of the study area while areas of moderate quality foraging habitat cover 12.79 ha (18.9%). Potential breeding habitat within the study area comprises areas with large Jarrah and/or Marri trees. High quality potential breeding habitat covers approximately 10.87 ha (16.1%) of the study area and moderate quality breeding habitat covers 1.06 ha (1.6%).
Wetlands	Approximately 31 ha of the study area is mapped wetland. This wetland has been assigned a wetland classification of Sumpland and Dampland with a management category of 'Multiple Use' which is a wetland which has few remaining important attributes and functions, except for local hydrological function.

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Appendix A Flora likelihood assessment

Species	Conservation Code ¹			Source ²			Likelihood assessment
	EPBC Act	WC Act	Parks and Wildlife	NatureMap	PMST	LandCorp dataset	
<i>Acacia flagelliformis</i>	-	-	P4	X	-	X	Potential to occur
<i>Acacia semitrullata</i>	-	-	P4	X	-	X	Known to occur
<i>Andersonia gracilis</i>	EN	S3	T	-	X	-	Unlikely to occur
<i>Austrostipa bronwenae</i>	-	S2	T	X	-	-	Unlikely to occur
<i>Banksia nivea</i> subsp. <i>uliginosa</i>	EN	S2	T	-	X	-	Unlikely to occur
<i>Banksia squarrosa</i> subsp. <i>argillacea</i>	VU	S3	T	-	X	-	Unlikely to occur
<i>Boronia juncea</i> subsp. <i>juncea</i>	-	-	P1	X	-	X	Potential to occur
<i>Brachyscias verecundus</i>	CR	S1	T	-	X	-	Unlikely to occur
<i>Caladenia huegelii</i>	EN	S1	T	X	X	-	Potential to occur
<i>Caladenia procera</i>	CR	S1	T	X	X	-	Unlikely to occur
<i>Caladenia speciosa</i>	-	-	P4	X	-	X	Known to occur
<i>Carex tereticaulis</i>	-	-	P3	X	-	-	Unlikely to occur
<i>Chamaescilla gibsonii</i>	-	-	P3	X	-	-	Unlikely to occur
<i>Chamelaucium</i> sp. S coastal plain (R.D.Royce 4872)	VU	S3	T	-	X	-	Unlikely to occur
<i>Cyathochaeta teretifolia</i>	-	-	P3	X	-	-	Unlikely to occur
<i>Darwinia whicherensis</i>	EN	S1	T	-	X	-	Unlikely to occur
<i>Dillwynia dillwynioides</i>	-	-	P3	X	-	X	Potential to occur
<i>Diuris drummondii</i>	-	S3	T	X	-	X	Potential to occur
<i>Diuris micrantha</i>	VU	S3	T	X	X	X	Potential to occur
<i>Diuris purdiei</i>	EN	S2	T	-	X	-	Potential to occur
<i>Drakaea elastica</i>	EN	S1	T	X	X	X	Potential to occur
<i>Drakaea micrantha</i>	VU	S2	T	X	X	X	Potential to occur
<i>Eleocharis keigheryi</i>	VU	S3	T	-	X	-	Unlikely to occur
<i>Lambertia echinata</i> subsp. <i>occidentalis</i>	EN	S1	T	-	X	-	Unlikely to occur
<i>Lasiopetalum membranaceum</i>	-	-	P3	X	-	X	Unlikely to occur
<i>Microtis quadrata</i>	-	-	P4	-	-	X	Potential to occur
<i>Pterostylis frenchii</i>	-	-	P2	X	-	-	Potential to occur
<i>Puccinellia vassica</i>	-	-	P1	X	-	-	Unlikely to occur
<i>Pultenaea skinneri</i>	-	-	P4	X	-	X	Potential to occur

Species	Conservation Code ¹			Source ²			Likelihood assessment
	EPBC Act	WC Act	Parks and Wildlife	NatureMap	PMST	LandCorp dataset	
<i>Synaphea</i> sp. Fairbridge Farm	CR	S1	T	-	X	-	Unlikely to occur
<i>Synaphea stenoloba</i>	EN	S1	T	-	X	-	Unlikely to occur
<i>Tripterococcus</i> sp. Brachylobus (A.S. George 14234)	-	-	P4	X	-	-	Potential to occur
<i>Verticordia attenuata</i>	-	-	P3	X	-	-	Potential to occur

¹CR = listed as Critically Endangered under the EPBC Act.

EN = listed as Endangered under the EPBC Act.

VU = listed as Vulnerable under the EPBC Act.

S1 = Schedule 1: Flora that are considered likely to become extinct or rare, as critically endangered flora (CR) under the WC Act.

S2 = Schedule 2: Flora that are considered likely to become extinct or rare, as endangered flora (EN) under the WC Act.

S3 = Schedule 3: Flora that are considered likely to become extinct or rare, as vulnerable flora (VU) under the WC Act.

T = Threatened species: flora that has been declared likely to become extinct or is rare, or otherwise in need of special protection, pursuant to section 23F(2) of the WC Act.

P1 = Priority 1: poorly known species that are known from one or a few locations which are potentially at risk, and are in urgent need of further survey. Listed by Department of Parks and Wildlife.

P2 = Priority 2: poorly known species known from one or a few locations, some of which are on lands managed primarily for nature conservation, and are in urgent need of further survey. Listed by Department of Parks and Wildlife.

P3 = Priority 3: poorly-known species known from several specimens or records but not under imminent threat, and need further survey. Listed by Department of Parks and Wildlife.

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring but not currently threatened; could become threatened if present circumstances change. Listed by Department of Parks and Wildlife.

²NatureMap = NatureMap database search (Parks and Wildlife 2007 - 2017)

PMST = EPBC Act Protected Matters Report (DoEE 2017b)

Appendix B Fauna likelihood assessment

Species	Conservation Status ¹		Source ²		Likelihood assessment
	WC Act / Parks and Wildlife	EPBC Act	NatureMap	PMST	
<i>Anous tenuirostris melanops</i> (Australian Lesser Noddy)	S2	VU	-	X	Unlikely to occur
<i>Ardea ibis</i> (Cattle Egret)	S5	-	X	-	Potential to occur
<i>Ardea modesta</i> (Eastern Great Egret)	S5	-	X	-	Potential to occur
<i>Botaurus poiciloptilus</i> (Australasian Bittern)	S2	EN	X	X	Unlikely to occur
<i>Calidris acuminata</i> (Sharp-tailed Sandpiper)	S5	M	X	-	Unlikely to occur
<i>Calidris canutus</i> (Red Knot)	S5	EN	-	X	Unlikely to occur
<i>Calidris ferruginea</i> (Curlew Sandpiper)	S3	CR	-	X	Unlikely to occur
<i>Calidris tenuirostris</i> (Great Knot)	S3	CR	X	-	Unlikely to occur
<i>Calyptorhynchus banksii</i> subsp. <i>naso</i> (Forest Red-tailed Black-Cockatoo)	S3	VU	X	X	Likely to occur
<i>Calyptorhynchus baudinii</i> (Baudin's Cockatoo)	S2	VU	X	X	Likely to occur
<i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo)	S2	EN	X	X	Known to occur
<i>Charadrius leschenaultii</i> (Greater Sand Plover)	S3	VU	X	-	Unlikely to occur
<i>Dasyurus geoffroii</i> (Chudutch, Western Quoll)	S3	VU	X	X	Potential to occur
<i>Diomedea amsterdamensis</i> (Amsterdam Albatross)	S1	EN	-	X	Unlikely to occur
<i>Diomedea dabbenena</i> (Tristan Albatross)	S1	EN	-	X	Unlikely to occur
<i>Diomedea epomophora</i> (Southern Royal Albatross)	S3	VU	-	X	Unlikely to occur
<i>Diomedea exulans</i> (Wandering Albatross)	S3	VU	-	X	Unlikely to occur
<i>Diomedea sanfordi</i> (Northern Royal Albatross)	S2	EN	-	X	Unlikely to occur
<i>Falco peregrinus</i> (Peregrine Falcon)	S7	-	X	-	Potential to occur
<i>Falsistrellus mackenziei</i> (Western False Pipistrelle)	P4	-	X		Unlikely to occur

Species	Conservation Status ¹		Source ²		Likelihood assessment
	WC Act / Parks and Wildlife	EPBC Act	NatureMap	PMST	
<i>Galaxiella nigrostriata</i> (Black-stripe Minnow)	S2	-	X	--	Unlikely to occur
<i>Hydromys chrysogaster</i> (Water-rat)	P4	-	X	-	Unlikely to occur
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i> (Quenda, Southern Brown Bandicoot)	P4	-	X	-	Potential to occur
<i>Ixobrychus dubius</i> (Australian Little Bittern)	P4	-	X	-	Unlikely to occur
<i>Leipoa ocellata</i> (Malleefowl)	S3	VU	-	X	Unlikely to occur
<i>Lerista lineata</i> (Perth Slider, Lined Skink)	P3	-	X	-	Potential to occur
<i>Limosa lapponica baueri</i> (Bar-tailed Godwit)	S3	VU	X	X	Unlikely to occur
<i>Limosa lapponica menzbieri</i> (Northern Siberian Bar-tailed Godwit)	S3	CR	-	X	Unlikely to occur
<i>Macronectes giganteus</i> (Southern Giant Petrel)	S5	EN	-	X	Unlikely to occur
<i>Macronectes halli</i> (Northern Giant Petrel)	S5	VU	-	X	Unlikely to occur
<i>Macropus irma</i> (Western Brush Wallaby)	P4	-	X	-	Potential to occur
<i>Merops ornatus</i> (Rainbow Bee-eater)	S5	-	X	-	Likely to occur
<i>Myrmecobius fasciatus</i> (Numbat)	S2	VU	X	-	Unlikely to occur
<i>Numenius madagascariensis</i> (Eastern Curlew)	S3	CR	X	X	Unlikely to occur
<i>Oxyura australis</i> (Blue-billed Duck)	P4	-	X	-	Unlikely to occur
<i>Pachyptila turtur subantarctica</i> (Fairy Prion)	-	VU	-	X	Unlikely to occur
<i>Phoebastria fusca</i> (Sooty Albatross)	S2	VU	-	X	Unlikely to occur
<i>Plegadis falcinellus</i> (Glossy Ibis)	S5	M	X	-	Unlikely to occur
<i>Pluvialis fulva</i> (Pacific Golden Plover)	S5	M	X	-	Unlikely to occur
<i>Pluvialis squatarola</i> (Grey Plover)	S5	M	X	-	Unlikely to occur
<i>Pseudocheirus occidentalis</i> (Western Ringtail Possum)	S1	VU	X	X	Potential to occur
<i>Rostratula australis</i> (Australian Painted Snipe)	S2	EN	-	X	Unlikely to occur

Species	Conservation Status ¹		Source ²		Likelihood assessment
	WC Act / Parks and Wildlife	EPBC Act	NatureMap	PMST	
<i>Setonix brachyurus</i> (Quokka)	S3	VU	-	X	Unlikely to occur
<i>Sternula nereis nereis</i> (Australian Fairy Tern)	-	VU	-	X	Unlikely to occur
<i>Thalassarche cauta cauta</i> (Shy Albatross)	S3	VU	-	X	Unlikely to occur
<i>Thalassarche cauta steadi</i> (White-capped Albatross)	S5	VU	-	X	Unlikely to occur
<i>Thalassarche impavida</i> (Campbell Albatross)	S3	VU	-	X	Unlikely to occur
<i>Thalassarche melanophris</i> (Black-browed Albatross)	S2	VU	-	X	Unlikely to occur
<i>Tringa glareola</i> (Wood Sandpiper)	S5	M	X	-	Unlikely to occur
<i>Tringa nebularia</i> (Common Greenshank)	S5	M	X	-	Unlikely to occur

¹CR = listed as Critically Endangered under the EPBC Act.

EN = listed as Endangered under the EPBC Act.

VU = listed as Vulnerable under the EPBC Act.

M = listed as Migratory species under the EPBC Act.

S1 = Schedule 1: Fauna that is rare or is likely to become extinct as critically endangered fauna (CR) under the WC Act.

S2 = Schedule 2: Fauna that is rare or likely to become extinct as endangered fauna (EN) under the WC Act.

S3 = Schedule 3: Fauna that is rare or likely to become extinct as vulnerable fauna (VU) under the WC Act.

S5 = Schedule 5: Migratory birds protected under an international agreement (IA) under the WC Act.

S7 = Schedule 7: Other specially protected fauna (OS) under the WC Act.

P3 = Priority 3: poorly-known species known from several specimens or records but not under imminent threat, and need further survey. Listed by Department of Parks and Wildlife.

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring but not currently threatened; could become threatened if present circumstances change. Listed by Department of Parks and Wildlife.

²NatureMap = NatureMap database search (Parks and Wildlife 2007 - 2017)

PMST = EPBC Act Protected Matters Report (DoEE 2017b).

Appendix C Banksia Woodlands TEC assessment

In order to determine whether the Banksia Woodlands of the Swan Coastal Plain TEC is present in the study area, key diagnostic characteristics must be met under Section 2 of the Conservation Advice (DotEE 2016).

For EPBC Act referral assessment and compliance purposes, the national ecological community is limited to patches that meet the key diagnostic characteristics (Step 1), condition thresholds (Step 2), and minimum patch sizes (Step 3).

Assessing the key diagnostic characteristics is the first step in identifying the ecological community, acknowledging that the ecological community encompasses a number of recognised sub-communities previously assigned as FCTs (Gibson et al. 1994).

Step two involves assessing the condition threshold of the study area. Condition threshold categories describe different values and functional attributes of the ecological community and the thresholds for their inclusion in the ecological community protected under the EPBC Act. It is recognised that any single patch of a TEC may be degraded to some degree but contributes to the overall function of the ecological community (and other environmental components) across the often fragmented landscape (DotEE 2016c).

Step three involves assessing the patch size as minimum patch sizes apply for consideration of a patch as part of the listed ecological community for EPBC Act referral, assessment and compliance purposes (DotEE 2016c). This concept recognises that even small, fragmented patches of a TEC can contribute to the overall function of the ecological community (and other environmental components) across the landscape.

Step four involves assessing further information to assist in determining the presence of the ecological community and significant impacts.

Step	Key diagnostic characteristics (DotEE 2016c)	Outcome
1	<p>Location and physical environment The Banksia Woodlands ecological community primarily occurs in the Swan Coastal Plain IBRA bioregion</p> <p>Soil and landform The Banksia Woodlands typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands</p> <p>Structure The structure of the Banksia Woodlands is a low woodland to forest with these features:</p> <ul style="list-style-type: none"> • A distinctive upper sclerophyllous layer of low trees* (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the Banksia species identified under composition • Emergent trees of medium or tall (>10 m) height <i>Eucalyptus</i> or <i>Allocasuarina</i> species may sometimes be present above the Banksia canopy • An often highly species-rich understorey that consists of: <ul style="list-style-type: none"> ○ a layer of sclerophyllous shrubs of various heights; and, ○ a herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history. <p>Composition</p> <ul style="list-style-type: none"> • The canopy is most commonly dominated or co-dominated by <i>Banksia attenuata</i> (candlestick banksia, slender banksia) and/or <i>B. menziesii</i> (firewood banksia). Other Banksia species that dominate in some examples of the ecological community are <i>B. prionotes</i> (acorn banksia) or <i>B. ilicifolia</i> (holly-leaved banksia); and • The patch must include at least one of the following diagnostic species: <ul style="list-style-type: none"> ○ <i>Banksia attenuata</i> (candlestick banksia) ○ <i>Banksia menziesii</i> (firewood banksia) 	<p>The study area is located on the Swan Coastal Plain</p> <p>The study area is located on Bassendean Dune System</p> <p>The vegetation communities CcBaKgXb, EmBiKgAs and EmKgMr contain <i>Eucalyptus marginata</i> subsp. <i>marginata</i> and/or <i>Corymbia calophylla</i> woodland with <i>Banksia attenuata</i> and/or <i>Banksia ilicifolia</i> over mixed midstorey and understorey which most commonly includes <i>Dasypogon bromeliifolius</i>, <i>Kunzea glabrescens</i>, and <i>Xanthorrhoea brunonis</i>.</p> <p>The canopy is dominated by <i>Eucalyptus marginata</i> and/or <i>Corymbia calophylla</i>, with the diagnostic species <i>Banksia attenuata</i> and/or <i>Banksia ilicifolia</i> which occurring as a low open woodland throughout. These vegetation communities also have a high diversity of shrubs and herb species. The contra-indicators of <i>Banksia littoralis</i> and <i>Banksia burdettii</i> were not recorded. The community does not represent FCT 20c – Eastern shrublands and woodlands.</p>

Step	Key diagnostic characteristics (DotEE 2016c)	Outcome
	<ul style="list-style-type: none"> ○ <i>Banksia prionotes</i> (acorn banksia) ○ <i>Banksia ilicifolia</i> (holly-leaved banksia). • If present, the emergent tree layer often includes <i>Corymbia calophylla</i> (marri), <i>E. marginata</i> (jarrah), or less commonly <i>Eucalyptus gomphocephala</i> (tuart); and • Other trees of a medium height that may be present, and may be codominant with the Banksia species across a patch, include <i>Eucalyptus tottiana</i> (blackbutt, pricklybark), <i>Nuytsia floribunda</i> (Western Australian Christmas tree), <i>Allocasuarina fraseriana</i> (western sheoak), <i>Callitris arenaria</i> (sandplain cypress), <i>Callitris pyramidalis</i> (swamp cypress) and <i>Xylomelum occidentale</i> (woody pear); and • The understorey typically contains a high to very high diversity of shrub and herb species that often vary from patch to patch*** • Contra-indicators: <ul style="list-style-type: none"> ○ Patches clearly dominated by <i>Banksia littoralis</i> are not part of the Banksia Woodlands ecological community but indicates a different, dampland community is present. ○ Patches clearly dominated by <i>Banksia burdettii</i> are not part of the Banksia Woodlands ecological community but indicates a tall shrubland and not the Banksia Woodlands ecological community. ○ FCT 20c – Eastern shrublands and woodlands, corresponds with a separate EPBC ecological community listing, Shrublands and Woodlands of the eastern Swan Coastal Plain. Occurrences of this FCT should be considered under that separate listing. 	
2	<p>Condition thresholds</p> <ul style="list-style-type: none"> • Assessments of a patch should initially be centered on the area of highest native floristic diversity and/or cover, i.e. the best condition area of the patch. • Consideration must be given to the timing of surveys and recent disturbance. Ideally surveys should be undertaken in spring with two sampling periods to capture early and late flowering species. • The surrounding context of a patch must also be taken into account when considering factors that add to the importance of a patch that meets the condition thresholds. 	These communities were assessed and sampled in the highest condition representation available in the study area.

Step	Key diagnostic characteristics (DotEE 2016c)	Outcome
	<ul style="list-style-type: none"> Certain vegetation components of the Banksia Woodlands ecological community merit consideration as critical elements to protect. Three components are recognised as threatened in their own right in WA and, as such, are priorities for protection; refer to Table 1 in the Approved Conservation Advice (DotEE 2016c). A relevant expert (e.g. ecological consultant, local NRM or environment agency) may be useful to help identify the ecological community and its condition. 	
3	<p>Minimum patch size</p> <p>Minimum patch sizes apply for consideration of a patch as part of the listed ecological community for EPBC Act referral, assessment and compliance purposes. Where patches meet different levels of condition, different minimum patch sizes apply:</p> <ul style="list-style-type: none"> ‘Pristine’ – no minimum patch size applies ‘Excellent’ – 0.5 ha or 5,000 m² (e.g. 50 m x 100 m) ‘Very Good’ – 1 ha or 10,000 m² (e.g. 100 m x 100 m) ‘Good’ – 2 ha or 20,000 m² (e.g. 200 m x 100 m). <p>Note: To be considered as part of the EPBC Act ecological community, a patch should meet at least the Good Condition category.</p>	<p>The areas of vegetation communities CcBaKgXb, EmBiKgAs and EmKgMr are presented in Table 3.</p> <p>These communities cover a total of 15.69 ha (23.2%) of which the following is in Good – Pristine condition:</p> <p>CcBaKgXb – 1.06 ha Very Good</p> <p>EmBiKgAs – 9.22 ha Excellent, 0.73 ha Very Good, 1.58 ha Good</p> <p>EmKgMr – 0.72 ha Excellent, 1.81 ha Good</p> <p>Total 15.12 ha of Good or better condition</p> <p>These communities within the study area therefore meet the condition requirements of at least a minimum of 2 ha of Good condition when considered in isolation from surrounding vegetation.</p> <p>The vegetation community is likely to make significant contributions to conservation, particularly in parts of the distribution where the community is very highly fragmented. This concept recognises that any single patch of a TEC may be degraded to some degree but contributes to the overall function of the ecological community (and other environmental components) across the landscape.</p>

Step	Key diagnostic characteristics (DotEE 2016c)	Outcome
4	<p>Further information to assist in determining the presence of the ecological community and significant impacts.</p> <ul style="list-style-type: none"> The landscape position of the patch, including its position relative to surrounding vegetation also influences how important it is in the broader landscape. For example, if it enables movement of native fauna or plant material or supports other ecological processes A patch is a discrete and mostly continuous area of the ecological community. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks. Where there is a break in native vegetation cover, from the edge of the tree canopy of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers; or due to water bodies typically more than 30m wide) then the gap typically indicates that separate patches are present. Variation in canopy cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and are often characterised by one or more areas within a patch that meet the key diagnostic characteristics and condition threshold criteria amongst areas of lower condition. Average canopy cover and quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall canopy cover and vegetation condition. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition categories that would apply across different parts of the site respectively. Where the average canopy cover or quality falls below the minimum thresholds, the next largest area or areas that meet key diagnostics (including minimum canopy cover requirements) and minimum condition thresholds should be specified and protected. This may result in multiple patches being identified within the overall area first considered. A buffer zone is a contiguous area immediately adjacent to a patch of the ecological community that is important for protecting its integrity. The purpose of the buffer zone is to help protect and manage the national threatened ecological community. The edges of a patch are considered particularly susceptible to disturbance and the presence of a buffer zone is intended to act as a barrier to further direct disturbance. 	<p>The vegetation communities CcBaKgXb, EmBiKgAs and EmKgMr represent occurrences of the Banksia Woodlands of the Swan Coastal Plain TEC as they meet all of the key diagnostic characteristics.</p>

Step	Key diagnostic characteristics (DotEE 2016c)	Outcome
	<ul style="list-style-type: none"><li data-bbox="297 304 1413 481">• The recommended minimum buffer zone for the ecological community is 20–50 metres from the outer edge of a patch, and the appropriate size depends on the nature of the buffer and local context (e.g. slope). A larger buffer zone should be applied, where practical, to protect patches that are of particularly high conservation value, or if patches are down slope of drainage lines or a source of nutrient enrichment, or groundwater drawdown.	

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